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**AN EARLY MIOCENE (ARIKAREEAN) FAUNA
FROM NORTHCENTRAL FLORIDA
(THE SB-1A LOCAL FAUNA)**

By
DAVID FRAILEY¹

The history of terrestrial vertebrates on the Florida peninsula after its presumed emergence in the Oligocene (White, 1942) is recorded in beach strand-line deposits and scattered karst fillings in the widespread marine limestones (see Olsen, 1965, 1968, for a review of Tertiary localities). The fragmentation of specimens inherent in beach deposits and the rarity of known bone-bearing sinkholes, either through their absence or through lack of discovery, has created a situation in which a few small localities, often with poorly preserved specimens, achieve great importance in any reconstruction of mid-Tertiary faunal diversity in Florida. For example, the Late Oligocene-Early Miocene North American Land Mammal Age, the Arikareean, is presently represented in Florida by only three local faunas: Brooksville (Patton, 1967a), Franklin Phosphate Pit No. 2 (Simpson, 1930), and SB-1A, the subject of this paper. Of these three, SB-1A has yielded the most diverse fauna and the greater number of taxonomically useful specimens.

Each of the three known Arikareean local faunas of Florida presents a slightly different aspect of faunal diversity in Florida in that each contains elements not found in the other three. SB-1A is the most unusual in this respect, and the most indicative of our present state of knowledge on this subject, in that none of its faunal members (with the possible exception of the higher taxon Anchitheriinae) are found in any of the other two local faunas; all are new additions to the Arikareean record of Florida.

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The SB-1A Local Fauna was first discovered by Mr. Wesley Hunt during a routine survey of quarries in North Florida in July, 1972, by the Timberlane Research Organization. A small amount of material was collected at this time but its significance was overlooked. Shortly thereafter, the site was rediscovered and brought to the attention of personnel in the Florida State Museum who referred to it as the Live Oak Locality. Both groups made sporadic superficial collections until December, 1974, when Mr. John S. Waldrop received word that the area was being planned for use as a dump for compacted garbage. During December, 1974, and March, 1975, with intermittent trips in between, Mr. Waldrop and field crews from the Timberlane Research Organization removed, washed, and sorted the material that forms the basis of this study. Recent work has not added to the taxonomic diversity of the fauna nor added to the representation of the rarer elements and justifies a systematic description of the fauna at this time.

The SB-1A Local Fauna occurs in an unstratified conglomeratic sequence above the Suwannee Limestone (Oligocene). The locality was exposed by limestone mining operations of Florida Rock Products, Inc., Shands and Baker Division, from which the S and B of the faunal name is derived. The site is located about one mile north of the small town of Live Oak, Suwannee County, Florida.

Tooth nomenclature follows that of Szalay (1969) and Patton and Taylor (1971). All measurements are in millimeters. "()" indicates an approximate measurement. The following institutional abbreviations are used: AMNH, American Museum of Natural History; CM, Carnegie Museum; F:AM, Friek American Mammals, American Museum of Natural History; TRO, Timberlane Research Organization, Rt. 2, Box 212B, Lake Wales, FL 33853; UF, University of Florida; UOMNH, University of Oregon, Museum of Natural History.

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Gooris. Ms. Deb Bennett assisted with stippling and layout. A special note of gratitude is extended to the officials of Florida Rock Products, Inc., for permission to collect on their properties.

GEOLOGY

The following information was provided by Mr. John S. Waldrop.

Site Stratigraphy.—The general stratigraphic section in the pit area is 20 to 30 feet of exposed Suwannee Limestone unconformably overlain by a conglomeratic sequence that is also 20 to 30 feet thick and capped by a reddish clay deposit or residuum that ranges from 0 to 7 feet in thickness, excluding sinkhole fillings. The conglomeratic sequence begins with a basal bed of reworked Suwannee Limestone boulders grading into an unstratified, poorly sorted, yellowish-white limestone conglomerate. The contact between the underlying Suwannee Limestone and the boulder bed is an undulating erosional surface. Three periods of activity, here referred to as Zones, are shown at the fossil site itself, as the main bone quarry rests on a second boulder bed consisting of boulders 3 to 4 feet in diameter and is overlain by a third boulder bed. The three conglomeratic zones are alternating, irregularly developed, unstratified beds with cobble-sized particles dominant in one area and pebble-sized particles dominant in another. There does not seem to be a pattern to the dispersion of these particles in the sequence, as they appear to alternate randomly within the plane of the bed. The thickness of the zones of the sequence is highly variable. Zone 1, the lowest bed, was the most nearly uniform bed, ranging in thickness from 8 to 10 feet. Zone 2, the middle bed, was observed to vary between 2 and 6 feet; and Zone 3, the upper bed, varied between 3 and 15 feet in the pit area. At the fossil site, Zone 1 is 8 feet thick, Zone 2 is 4 to 5 feet thick, and Zone 3 is 15 feet thick.

The vertebrate fossils occur in the finer matrix of the unstratified, poorly sorted, yellowish-white limestone conglomerate in Zone 2. This finer matrix consists of a white to yellowish-white argillaceous calcarenite with blebs and stringers of almost pure green clay with white clay surrounding many of the larger particles. During quarry operations in March, 1975, a small lens of clay was encountered in the lower part of the quarry. This lens was about 2 feet thick and extended laterally for about 4 feet. The conglomeratic particles are reworked Suwannee Limestone, some of which are virtually unweathered (although strongly recrystallized as is the Suwannee Limestone in this area) and some of which are weathered to a limestone saprolite. The white clay is probably derived from this saprolite as it generally occurs within crevices in and surrounds these saprolitic particles for 1 to 6 inches. The conglomeratic fraction ranges from pebble-sized to boulder-sized particles with the pebble and cobble sized particles being most numerous. The

more strongly recrystallized particles are well rounded but some are angular or subangular and nearly all are roughly spheroidal in shape, although many show concavities due to erosion.

The bone is, overall, very well permineralized and preserved, although often badly broken by expansion and contraction of the clay inside and around the bone. A few bones are badly weathered and crumbly, however, and some were not collectable. Generally, the bone in the white clay either shows the least permineralization or greatest post-depositional weathering. Numerous well permineralized angular bone and tooth fragments occur throughout the site. There was little evidence of association of postcranial elements in the site and no cranial-postcranial association. In several instances associated groups of camel teeth were found in their natural sequence but without any trace of the jawbone. In other instances, the jawbones had been completely shattered but were in association with the teeth. This shattering appears to have occurred due to the expansion and contraction of the clay within the cavities in the jaws. This phenomenon would explain the extreme rarity of complete mandibles and the absence of the resistant skulls.

The main fossil quarry is located in Zone 2 although some bone fragments, possibly due to stratigraphic leakage, were found in Zone 1, and a few bone fragments, possibly reworked, occur in Zone 3. Neither Zone 1 nor Zone 3 were found to be rich enough to warrant quarry operations. The apparent absence or extreme scarcity of bone from the remainder of the conglomeratic sequence has not been satisfactorily explained. It should be pointed out, however, that due to the vertical and unstable nature of much of the pit wall, continuous direct observation could not be made in the interest of safety. Field observation resulted in no apparent reason for the concentration of bone in this one small area. Slumping and heavy vegetative growth have also hampered research into this problem and the question is as yet unresolved.

Although no well defined bedding planes were observed by close examination during excavation of the main bone quarry, the overall appearance of the conglomeratic sequence at a distance of one-half mile suggests that the three boulder beds are essentially horizontally bedded. Even though the zones thicken and thin and, as a result, the contacts between the basal boulder beds and the upper part of the underlying conglomeratic zones are wavy and undulating, no sharply dipping beds or angular unconformities were observed. Sinkhole development was not apparent within any of the zones. The horizontality of the beds was much more apparent at a distance, however, than close up, and no appearance of bedding was observed within any of the zones.

The upper surface of the conglomeratic sequence is very irregular and undulating, but it has not been determined whether this

was a naturally undulating erosional surface or was influenced by karst activity or perhaps by a combination of the two. The above mentioned horizontality of the beds would suggest that the dominant effect was one of erosion.

The conglomeratic sequence is unconformably overlain by an orangeish-red and gray mottled clay or sandy clay representing what is thought to be a residuum and soil profile, but is possibly a sedimentary deposit. This clay rests upon either the pebble or cobble conglomeratic material of Zone 3, depending upon the size particle that is dominant in that particular area. The unconformable nature of the contact between this upper clay and the upper part of the conglomeratic sequence, without the development of a weathering profile, might be one reason for considering the clay a sedimentary deposit or redeposited residuum. The absence of a weathering profile is puzzling as the geologic history of the area indicates a long period of subaerial exposure, a period of at least post-Hemphillian (Early Pliocene). Where the section along the pit wall has not been obscured or disturbed by mining activity, vegetative growth, or slumping, sinkholes are seen to be developed down into and through the conglomeratic sequence. These sinkholes are filled with a red or gray sandy clay or clay alone. The sinkholes near the main quarry that were studied in detail are filled with a blocky, orangeish-red and gray mottled clay or sandy clay. The overall appearance is a reddish color but with much gray locally. As this clay seems to be the same as the surface veneer, the formation of, or at least collapse of, these sinkholes must have been subsequent to the time of deposition of the conglomeratic sequence. The depth of the observed sinkholes ranges from 1 to more than 50 feet.

Mode of Formation and Significance of Deposit.—The site would seem to be one of proximal deposition with little transport as evidenced by the associated, but loose, teeth. Reworked Suwannee Limestone invertebrates are common in the site. These consist of casts of mollusks, echinoids and echinoid spines, and tubes or burrows of invertebrates. Younger invertebrates are totally absent. This is surprising due to the abundance of early to middle Miocene mollusks in deposits along the Suwannee River about 15 miles northeast of the site (Brooks, 1966). A similar yellowish clay about 10 miles north of the site contains numerous silicified specimens of *Ostrea normalis* associated with and stratigraphically below a middle Miocene land vertebrate fauna. Except for some as yet unidentified frog and snake remains, the vertebrate fauna from SB-1A is strictly terrestrial. There is a definite absence of freshwater fishes, alligators, and freshwater turtles as well as the marine sharks and rays that are common in many other Miocene vertebrate faunas of Florida. The erosion and pitting on some bone and many of the teeth suggests that the bone lay in the open for a period of time before being covered.

The sediments, especially the cobbles and boulders, suggest considerable current energy, if transported by water. The poorly sorted sediments indicate rapid transport and deposition. The total absence of any marine or freshwater animals of similar age in association with the fauna suggests a means of transport other than water, although it is conceivable that the aqueous environment could have been present without these forms becoming entombed within the sediments.

In a paper on the geological history of the Suwannee River, Brooks (1966) makes several statements that might suggest an answer to this seeming paradox. In speaking of the structures of an area approximately 15 miles to the northeast of SB-1A, Brooks discusses the stratigraphic displacement in the narrow belt between the karst plain and the high flatland physiographic entities. He also suggests the possibility that this displacement, which is commonly 60 or more feet, is due to faulting. The SB-1A Locality lies very near the boundary between the karst plain, which the site is located upon, and the high flatlands just to the north and northeast of the site. Displacement of 60 or more feet in the vicinity of SB-1A with its attendant mass wasting and colluvial transport, could provide the conditions necessary for the rapid transport and deposition of poorly sorted sediments that contain particles ranging from clay to boulder size. This would also explain the extreme variability in the dispersion of particle sizes and the unstratified nature of the sediments. The appearance in the fauna of only terrestrial vertebrates is also explained as is the absence of marine or freshwater forms. If younger marine sediments were deposited in this area they have since been eroded, except perhaps for the upper clay veneer. It should be born in mind that definite proof for this hypothesis is lacking at present although it best explains this otherwise puzzling catastrophe of nature. Younger sediments occur at similar elevations to the north and northeast. A similar widespread catastrophe of a similar age is also present in south-central Florida, again in the same geologic setting. If this hypothesis can be proven, then it indicates that uplift and erosion of the Ocala Arch continued into the late Early Miocene and is perhaps the best direct evidence for uplift and erosion of the Ocala Arch.

SYSTEMATIC ACCOUNTS

ORDER CARNIVORA Bowdich, 1821

FAMILY AMPHICYONIDAE Trouessart, 1885

GENUS Mammacyon Loomis, 1936

Mammacyon cf. *obtusidens* Loomis, 1936

Figs. 1A-G

Discussion.—Familial rank follows Hunt (1972). The M¹ (TRO 390) of a large carnivore in the SB-1A Local Fauna is immediately

referable to either *Mammacyon* or *Temnocyon* on the characteristic prominence of three cusps, the paracone, metacone, and the centrally located protocone, and the anteroposterior expansion of the tooth at the protocone. The latter characteristic gives the tooth a rough "figure 8" outline in occlusal view. The very large size of

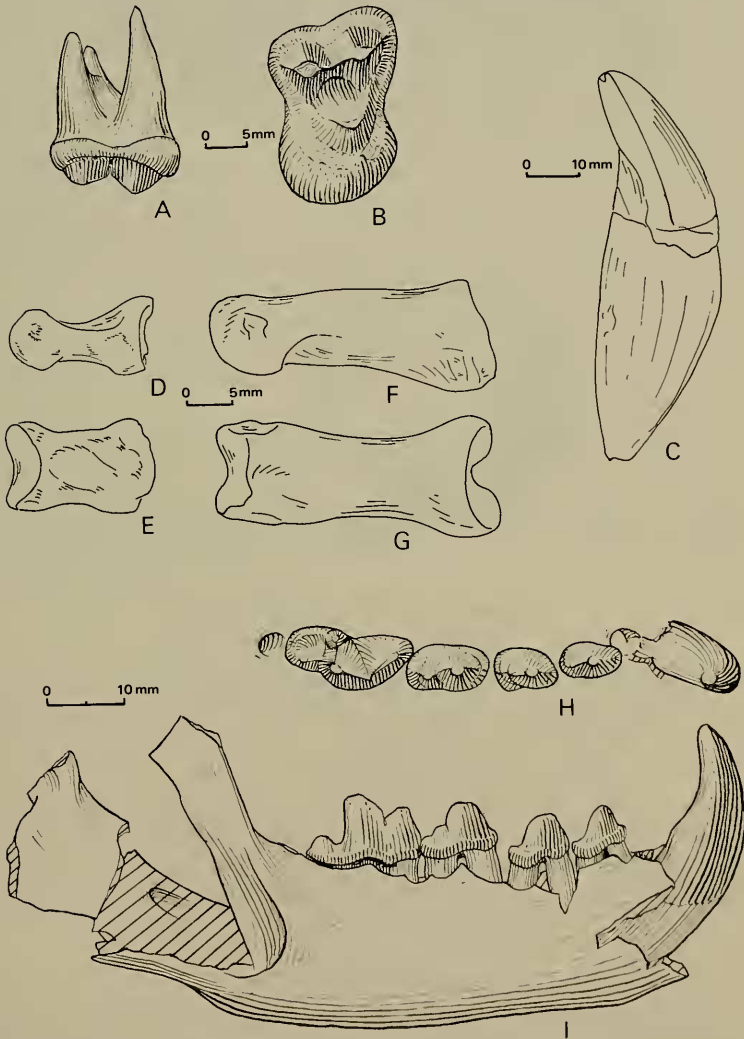


FIG. 1.—A-G. *Mammacyon* cf. *obtusidens*. A. M¹, TRO 390, labial view; B. M¹, TRO 390, occlusal view; C. Lower canine, TRO 388, labial view; D. Medial phalanx, TRO 387, lateral view; E. Medial phalanx, TRO 387, dorsal view; F. Proximal phalanx, TRO 386, lateral view; G. Proximal phalanx, TRO 386, dorsal view. H-I. *Paroligobunis frazieri* n. sp., UF 23928, holotype. H. Occlusal view of dentition; I. Labial view of ramus.

the protocone and the wide expansion of the tooth at the protocone and a heavy lingual cingulum are more like *Mammacyon obtusidens* and the referral is made on that basis.

The size of the M¹ (17.7 x 24.4, length x width) is close to that of *Mammacyon obtusidens* although the relative expansion of the protocone area (expressed as a ratio of labial length/labial width across the protocone, Hunt, 1971) is greater than in *M. obtusidens* (1.1 vs. 1.32-1.36). This greater expansion of the tooth in this area may be no more than an extreme of individual variation or may later prove to be a species distinction. The uncertainty on this point prevents certain referral of this specimen to *M. obtusidens*.²

A right lower canine (TRO 388, Fig. 1C), presumably of *Mammacyon* cf. *obtusidens* because of its size, has a long, flat wear facet from its tip to the base of the crown. The advanced wear of this tooth contrasts with the slight wear on the M¹ and indicates the presence of more than one individual in the deposit.

A proximal and a medial phalanx from SB-1A (TRO 386; 387; Figs. 1D-G) are attributed to *Mammacyon* cf. *obtusidens*. In size and proportions they are similar to those of *Daphoenodon superbus* as described by Peterson (1910).

Mammacyon obtusidens occurs in Arikarean beds (Monroe Creek and possibly Harrison formations) of South Dakota and Nebraska with a single specimen recorded from the Upper John Day beds (Hunt, 1971). This referral indicates a Monroe Creek or possibly Harrison age equivalence for the SB-1A Local Fauna.

SUBFAMILY CANINAE Gill, 1872

?*Mesocyon* Scott, 1890

Discussion.—A medium-sized canid is represented in the fauna by a single, badly damaged P¹ (TRO 391) which is missing the protocone. This tooth is questionably referred to *Mesocyon* because it lacks a large parastyle, as do the P¹s of *Mesocyon*, and because *Mesocyon* is the only canid of this size which occurs in the Arikarean, the age indicated by the other faunal members. *Tomarctus* and *Cynodesmus* are of this size range but have a large parastyle on P¹ and occur in Hemingford and later times.

Phlaocyon sp. Matthew, 1899

Figs. 2A-B

Discussion.—The P¹, TRO 392, from SB-1A is smaller than the P¹ on the holotype of *P. leucosteus* (AMNH 8768) and has a relatively smaller hypocone. A small, accessory cusp is present on the

²Dr. R. M. Hunt is currently studying the taxonomy and relationships of *Temnocyon* and *Mammacyon*. He has generously allowed me to draw upon his work in progress but a more complete discussion of these genera must await his paper.

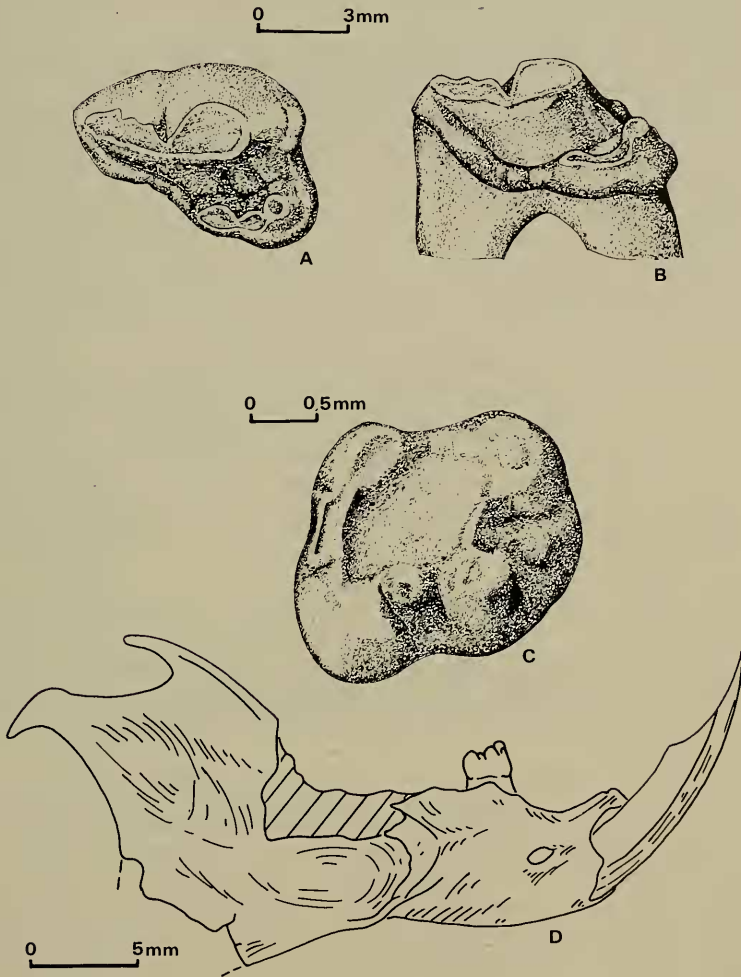


FIG. 2.—A-B. *Phlaocyon* sp., right P^1 , TRO 392. A. Occlusal view; B. Lingual view. C-D. *Protosciurus* sp., right ramus with lower incisor and P_4 , TRO 401. C. Occlusal view of P_4 ; D. Labial view of ramus.

anterior cingulum of the SB-1A P^1 which is absent on that of *Phlaocyon leucosteus*. *Phlaocyon marslandensis* (McGrew, 1941) is even larger than *P. leucosteus* but shares the features of P^1 with *P. leucosteus* which contrast with the P^1 from SB-1A.

The P^1 of *Phlaocyon* found at SB-1A could be within the limits of variation for *P. leucosteus*. On the other hand, the species of *Phlaocyon* from SB-1A may be new but certain identification is not possible with the material at hand.

Measurements of the P¹ from SB-1A and that of *P. leucosteus* are compared in Table 1.

TABLE 1.—Comparative measurements (mm) of P¹ of *Phlaocyon* sp. from SB-1A and of *Phlaocyon leucosteus* (AMNH 8768, holotype).

Character	<i>P. leucosteus</i>	<i>Phlaocyon</i> sp.
greatest length	10.8	8.7
greatest width (protocone across paracone)	7.7	6.8
width (in occlusal position)	7.3	6.3

FAMILY MUSTELIDAE Swainson, 1835

GENUS *Paroligobunis* Peterson, 1906

Paroligobunis frazieri, new species

Fig. 1H-I

Etymology.—Named for Michael Frazier, whose skill in preparation saved this specimen and in honor of his work in Florida paleontology.

Holotype.—UF 23928, right ramus with C₁, P₂-M₁; P₁ and M₂ alveoli.

Diagnosis.—Ramus more slender than in *P. simplicidens* or *P. petersoni*. Premolars less crowded than in either species. *Paroligobunis frazieri* is larger than *P. petersoni* but slightly smaller than *P. simplicidens*.

Description and Comparisons.—The shortened M₁ with a strong labial convexity is characteristic of *Oligobunis* and *Paroligobunis* and serves to separate these genera from other mustelids of this size range. The ramus from SB-1A is further referable to *Paroligobunis* (using CM 1553, holotype of *P. simplicidens*) and not *Oligobunis* (using AMNH 6903, holotype of *O. crassivultes*) on dental features. *Paroligobunis*, and the SB-1A ramus, has a smaller M₁ than *Oligobunis*; a larger P₁ (P₁ of *Oligobunis* is reduced to a simple, insignificant peg); no diastemata between the premolars (small diastemata are present between P₁-P₂ and P₂-P₃ of *Oligobunis*); and in not having an entoconid on M₁ as does *Oligobunis*.

Paroligobunis simplicidens (Peterson, 1910) and *P. petersoni* (Loomis, 1932) are the only species of this genus currently recognized as valid. *Paroligobunis frazieri* differs from *P. simplicidens* in being slightly smaller (see Table 2); in having a more slender ramus (in depth and width); the premolars of *P. frazieri* are less massive than those of *P. simplicidens*; P₂ and P₃ are less crowded (P₂ in *P. simplicidens* has been crowded in the tooth series to the point that it is rotated, labially, about 30°); P₂ and P₃ of *Paroligobunis frazieri*

are not broadly widened, posteriorly, as are those of *P. simplicidens*; and P_2 and P_3 of *P. frazieri* have a more distinct posterior cingulum than do these premolars in *P. simplicidens*. The apparent less crowding of the premolars in *P. frazieri* may be an artifact of the reconstructed mandible but it appears to be natural. The rotation of P_2 in *P. simplicidens* places this tooth parallel to the sagittal section of the animal. In *P. frazieri*, P_2 is in line with the tooth row.

Paroligobunis petersoni, according to Loomis (1932), is much smaller than either *P. simplicidens* and hence also of *P. frazieri*. *Paroligobunis petersoni* also has a massive mandible in agreement with *P. simplicidens* and in contrast to the light ramus of *P. frazieri*.

Discussion.—*Paroligobunis simplicidens* occurs in the Harrison Formation (late Arikareean) of Nebraska (Peterson, 1910). *Paroligobunis petersoni* was discovered in beds of "Upper Harrison" age (=Hemingfordian, Schultz and Falkenbach, 1968) near Van Tassel, Wyoming. These two species are probably more closely related to each other than either is to *P. frazieri* as a massive mandible, present in both species, is very likely a derived character in this genus.

Oligobunis and *Paroligobunis* are undoubtedly closely related. *Oligobunis* is known from the Thomas Farm Local Fauna (Late Hemingfordian) of Florida (*Oligobunis floridanus*). The relationship between *O. floridanus* and *P. frazieri* is not readily apparent but is probably no closer than for other species in each genus.

TABLE 2.—Comparative measurements (mm) of *Paroligobunis frazieri*, new species, and *P. simplicidens*.

Character	<i>P. frazieri</i> (UF 23928)	<i>P. simplicidens</i> (CM 1553, holotype)
Length, P_1 - M_2	49.0	54.2
C_1 (length)	9.5	11.2
(width)	7.5	8.2
P_2 (length)	7.4	8.8
(width)	4.8	5.7
P_3 (length)	8.1	9.7
(width)	5.6	6.9
P_4 (length)	10.8	11.6
(width)	6.1	7.0
M_1 (length)	15.7	(16.4)
(width)	7.1	(7.6)
Depth of mandible (below M_1)	21.8	25.4
Width of mandible (at M_1)	10.2	13.0

ORDER CARNIVORA

Gen. et sp. indet.

Fig. 3A-B

Discussion.—An isolated metatarsal II (TRO 402) of an unidentified carnivore is illustrated in Fig. 3A-B. The features of the articular surfaces are obscured by an apparent osteopathy which renders taxonomic referral inconclusive. The size of the metatarsal is between that expected for *Phlaocyon* or *Mesocyon*, the two carnivores in the fauna which are nearest in size, and the size one would expect for an animal like *Leptocyon* or *Nothocyon*.

The carnivore which possessed this metatarsal was digitigrade and the metatarsals were not closely appressed. The distal articulation is rounded with only a posterior keel and has much the appearance of a felid distal articulation.

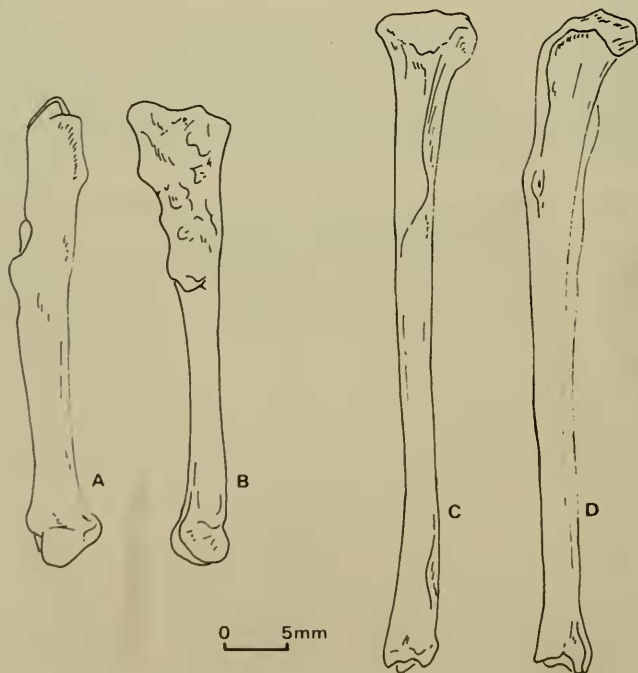


FIG. 3.—A-B. Carnivora gen. et sp. indet., right metatarsal II, pathologic, TRO 402. A. Dorsal view; B. Lateral view. C-D. *Protosciurus* sp., left tibia, TRO 400. C. Anterior view; D. Lateral view.

ORDER PERISSODACTYLA Owen, 1848
 FAMILY EQUIDAE Gray, 1821
 SUBFAMILY ANCHITHERIINAE Osborn, 1910
 Gen. et sp. indet.

Discussion.—An anchitherine horse about the size of *Parahippus leoneensis* is represented in the SB-1A Local Fauna by a single lateral metapodial (TRO 393). The scarcity of horse material from this deposit, and the evident rarity of horses in the vicinity during deposition, is an intriguing problem for which there is no satisfactory answer. In this respect SB-1A stands in sharp contrast to the Hemingfordian faunas in Florida, especially Thomas Farm, in which horses are abundantly represented.

ORDER ARTIODACTYLA Owen, 1848
 SUBORDER TYLOPODA Illiger, 1811
 FAMILY CAMELIDAE Gray, 1821
 GENUS *Nothokemas* White, 1947
Nothokemas waldropi, new species

Fig. 4

Etymology.—Named for John S. Waldrop, who collected this material, in respect for his diligent stratigraphic paleontology.

Holotype.—UF 23927, left ramus with C₁, P₂-M₃.

Diagnosis.—About 1/2 the size of *N. floridanus* and *N. hidalgensis*, the only previously recognized species of *Nothokemas*.

Description and Comparisons.—Lower Dentition: The lower incisors are spatulate, thin, and form a closely set, fan-shaped group in which I₂ and I₃ each slightly overlaps the incisor in front.

The lower canine tooth is long and strongly recurved.

The first lower premolar is not present in this genus and its absence has been used as part of a generic description by Patton (1969). As can be seen on a radiograph of the holotype of *N. waldropi*, on file at the Timberlane Research Organization, the P₁ is truly absent and not merely suppressed.

A long diastema separates C₁ from P₂. The dorsal border of the diastema drops quickly between C₁ and P₂ apparently as a result of the missing P₁.

P₂ is a simple, linear tooth. The central cusp is prominent. P₂ and P₃ are relatively thinner than these teeth in *N. floridanus* and *N. hidalgensis*.

P₃ is clongate and slender. A lingual styloid is present which arises just posteriorly to the protoconid and which may extend to the rear margin of P₃ or less than half that distance depending upon the individual.

P₄ is typically camelid in appearance with its widest part at the hypoconid giving the characteristic wedge-shape to the tooth.

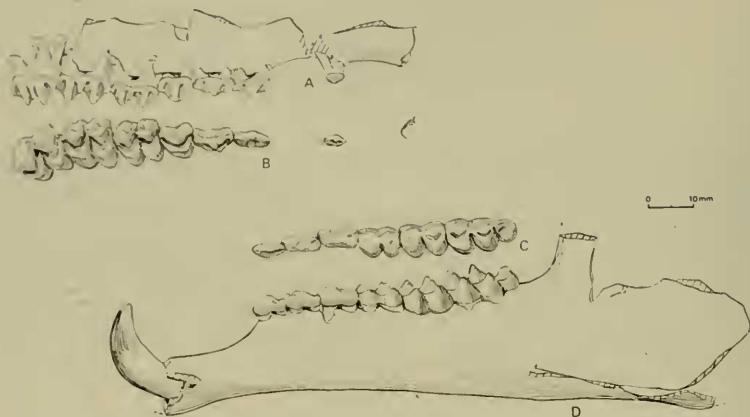


FIG. 4.—*Nothokenas waldropi* n. sp. A. Right P^1 - M^3 with partial maxilla, TRO 389, labial view; B. TRO 389, occlusal view; C. UF 23927, holotype, left ramus with C_1 , P^2 - M^3 , occlusal view of dentition; D. UF 23927, holotype, labial view.

The lower molars have the discontinuous and overlapping crests which are typical of oxydaetyline camels in which the posterior crest unites first with the anterior ereseent, and not the anterior erest, during wear. Intercolumnar styles are generally absent, but slight styles are present on molars of some individuals and are presumed to be only another example of individual variation in this species. Internal ribs are faintly discernible on the crests.

A small extension of the posterior crest (entoconid) which is present on the M_3 of two individuals (TRO 357, 360) is suggestive of the "double-enamel loop" of *Floridatragulus* (Patton, 1969). The posterior terminus of the posterior crest of M_3 in *N. waldropi* is apparently also individually variable.

Upper dentition: I^1 - I^2 are unknown; I^3 is large, curved, and labially-lingually flattened. Small blades are present on the anterior and posterior margins. The diastema between I^2 and I^3 was small, approximately 2 mm in length.

C^1 is curved, caniniform, and larger than I^3 or P^1 .

P^1 is a simple, short-bladed tooth as is also seen in *Oxydactylus*. P^1 is double-rooted but the roots are fully fused.

P^2 is an elongate, tricuspid tooth which has a simple linear enamel pattern. The protocone is located anterior to the center of the tooth and is the most prominent cusp. Other than the P^2 of *Floridatragulus*, the P^2 of *Nothokenas waldropi* is the longest, relative to P^3 , among all the genera examined. The length of P^2 approximates that of P^3 .

P^3 , like P^2 , appears to be elongated antero-posteriorly. This effect is produced in part by the small size of the internal ingulum.

This cingulum does, however, have two distinct cuspules which are located above the medial root near the protocone. The overall appearance is like the P³ of *Oxydactylus longipes*.

P⁴ is simple, camelid-like in shape and pattern and undiagnostic except by its small size. Only a very slight cingulum is present on the posterior part of the crescent on a few individuals while totally absent in others.

The upper molars are characteristically oxydactyline in their low crown height, prominent ribs and styles (particularly the mesostyle), and the non-linear overlap of the anterior crest (paracone) by the posterior crest (metacone). The external ribs are only slightly less prominent than the mesostyle (as in all oxydactyline genera except *Miolabis*). Intercolumnar styles are almost totally lacking although occasionally found on M³. These styles are more frequently distributed among other genera of camels with the oxydactyline molar pattern although subject to some degree of individual variation in *Miolabis* and *Oxydactylus*. The anterior crescent may bifurcate posteriorly, again determined by individual variation, reminiscent of the bifurcation seen in xiphodonts and in some individuals of *Poebrotherium*.

Dental measurements of *Nothokemas waldropi* are given in Table 3.

TABLE 3.—Measurements (mm) of the teeth of *Nothokemas waldropi*

Character	UF 23927 (holotype)	TRO 360	TRO 389
Depth of ramus beneath M ₁	18.5	14.5	—
Depth of ramus beneath P ₄	18.3	13.8	—
P ₂ -M ₃	59.9	56.3	—
P ₃ -P ₄	16.9	15.4	—
P ₃ -M ₃	52.9	49.8	—
M ₁ -M ₂	36.2	34.4	—
P ₃ (L x W)	8.3 x 3.3	7.2 x 2.8	—
P ₄	8.6 x 4.5	8.3 x 4.1	—
M ₁	9.7 x 6.7	9.5 x 6.4	—
M ₂	11.0 x 7.9	10.6 x 7.0	—
M ₃	16.2 x 8.3	14.6 x 6.9	—
C ¹ -P ¹ diastema	—	—	13.4
P ¹ -P ² diastema	—	—	11.9
P ² -M ³	—	—	58.8
P ¹ (L x W)	—	—	4.7 x 2.2
P ²	—	—	8.1 x 3.5
P ³	—	—	8.8 x 4.9
P ⁴	—	7.6 x 7.6	7.6 x 7.8
M ¹	—	10.8 x 9.7	10.9 x 10.2
M ²	—	11.6 x 12.0	12.5 x 12.1
M ³	—	11.9 x 11.7	12.6 x 11.9

Discussion.—The genus *Nothokemas* was first recognized by White (1947) who placed it in a new family, the Nothokemadidae, *incertae sedis*, within the Hypertraguloidea. Patton (1969) reinterpreted the hypertraguloid features of *Nothokemas* as plesiomorphic for artiodactyls and transferred *Nothokemas* to the Family Camelidae, Subfamily Aepycamelinae Webb, 1965. The Aepycamelinae is probably a paraphyletic group and at present contains such genera as *Oxydactylus*, *Aepycamelus*, *Paratylopus*, and *Miolabis* (Webb, 1965; Simpson, 1945).

Nothokemas is undoubtedly similar to *Oxydactylus* and could logically be placed within the Aepycamelinae, but, because of the questionably validity of that subfamily, I have chosen instead to refer to *Nothokemas* as an "Oxydactylus-like camelid" in reference to the characteristic molar pattern shared by these two genera. Other *Oxydactylus*-like camelids are *Miolabis*, *Gentilicamelus*, and *Floridatragulus*, but decidedly not *Paratylopus*. *Paratylopus* is a slightly advanced poebrothere. *Aepycamelus* is probably closely related to *Oxydactylus* but has modified the *Oxydactylus* molar pattern through hypsodonty, a derived condition possibly indicative of relationship with *Procamelus* and later camels. The inclusion of *Floridatragulus* in this group appears at first to be inappropriate in view of the striking features of this genus which have led to its placement in the monotypic Subfamily Floridatragulinae Maglio, 1966. Many of the characters of *Floridatragulus*, however, are primitive ruminant characters as recognized by Patton (1969) and are of no use in phylogenetic grouping. The most unusual features are the greatly elongated muzzle and the double enamel loop or divided hypoconid on M_3 . The elongated muzzle is certainly autapomorphic but the double enamel loop may not be. The resemblance of the small posterior extension of the posterior crest as seen on some individuals of *Nothokemas waldropi* to the lingual half of the double enamel loop of *Floridatragulus* suggests an hypothesis for the origin of this characteristic feature of *Floridatragulus*. A further extension of the posterior crest (the entoconid) of M_3 onto the talonid would produce a typical double enamel loop. A similar degree of variation in the posterior limit of the posterior crest of M_3 is seen in some individuals of *Miolabis* (F:AM 68985, 68988) from Trinity River, Texas (Barstovian), and supports the contention that the double enamel loop of *Floridatragulus* is not as exceptional as White (1940, 1947) and Patton (1967b, 1969) believed. These enamel loops on the talonid of M_3 would then not be homologous with those of hypertragulids in which both crests of the talonid of M_3 probably arose from two small crests which run anteriorly from the single cusp on the talonid, the hypoconid, as can be seen in *Archaeomerix* and other early artiodactyls.

Nothokemas was previously known from the Hemingfordian of

Florida and Texas (Patton, 1969). The occurrence of *Nothokemas* in the SB-1A fauna is the earliest occurrence of this characteristic Gulf Coast genus.

ORDER RODENTIA Bowdich, 1821

SUBORDER SCIUROMORPHA Brandt, 1855

FAMILY SCIURIDAE Gray, 1821

TRIBE SCIURINI Burmeister, 1854

GENUS *Protosciurus* Black, 1963

Protosciurus sp.

Figs. 2C-D, 3C-D

Discussion.—A partial right ramus with the incisor and P_4 (TRO 401) and a tibia (TRO 400) of a squirrel are the only indication of small mammals in the SB-1A fauna.

The P_4 of the squirrel from SB-1A, unlike the P_4 s of most genera of squirrels, does not have a laterally compressed trigonid or radically enlarged hypoconid and retains a basically unmodified tree squirrel tooth pattern as is seen in *Protosciurus*. The following description of the P_4 from SB-1A, using the terminology of Black (1963), is also applicable, except where noted, to the P_4 s of *P. mengi* and ?*Protosciurus jeffersoni* (referral of Black, 1965). The P_4 of *Protosciurus condoni* has been figured by Black (1963) but it is damaged and little can be said about it. The P_4 s of the other species of *Protosciurus* are unknown.

The trigonid of P_4 is composed of a clearly defined protoconid and metaconid which are well separated yet connected by a metalophid anterior to which is a trigonid basin and a small, knob-shaped anterior cingulum, the ?paraconid. The protoconid and metaconid are not well separated on the P_4 of ?*P. jeffersoni* and an elongate anteroconid is present on the protoconid which may be equivalent to the knob on the anterior cingulum of *P. mengi* and the *Protosciurus* from SB-1A. The metaconid on the P_4 from SB-1A is strongly cone-shaped (as are the protoconid and hypoconid), whereas in *P. mengi* the metaconid is less clearly separable from the anterior rim of P_4 . The protoconid is placed slightly posteriorly to the metaconid. The protoconid and metaconid are not appressed³ and are approximately of the same size. The hypoconid is slightly larger and creates a postero-labial swelling on the otherwise square to rectangular occlusal outline. In all other genera of squirrels, the

³ The P_4 on the holotype of *P. condoni* (UOMNH F-5171) is badly damaged but the protoconid and metaconid appeared to be closely appressed to Black (1963). On a referred specimen in the American Museum of Natural History, *Protosciurus* cf. *condoni* (F:AM 99254), the metaconid and protoconid of P_4 appear to be relatively closely placed due to the much larger size of the metaconid relative to the protoconid than is seen on the P_4 's of either *P. mengi* or the squirrel from SB-1A.

relatively great size of the hypoconid, combined with the laterally compressed trigonid, produces a more triangularly shaped P_4 . The rim of the talonid is continuous between the hypoconid and a distinct entoconid. A mesoconid is present on a faint cetolophid. The mesostylid is represented by a slight rise on the posterior of the metaconid.

The ramus also has features of *Protosciurus* as given by Black (1963) in his diagnosis of the genus: The masseteric fossa ends anteriorly beneath M_1 ; the diastema is short; the diastemal depression is deep; and the mental foramen is positioned well below the depression of the diastema.

Without including *?P. jeffersoni*, four species of *Protosciurus* have been described (Black, 1963). Listed in decreasing order of size, these are: *Protosciurus condoni*, *P. tecuyensis*, *P. mengi*, and *P. rachelae*. The P_4 of *Protosciurus* sp. from SB-1A is slightly smaller than that of *P. mengi* and differs in having a more distinct metaconid. The P_4 from SB-1A measures 2.1 x 1.7 mm versus 2.5 x 2.2-2.5 for *P. mengi* (Black, 1963).

The ramus from SB-1A has a small muscle scar anterior to the masseteric fossa as does *P. tecuyensis* but unlike *P. condoni* (unknown in *P. mengi* and *P. rachelae*). The masseteric fossa on the SB-1A ramus is deeper than on the species of *Protosciurus* for which this fossa is known (all except *P. rachelae*).

A complete tibia (TRO 390) from the SB-1A locality is referred to *Protosciurus* sp. on the basis of its size and sciuriform features. The significance of this specimen lies in its greater resemblance to tibiae of arboreal squirrels (*Sciurus*, *Tamiasciurus*) than to those of ground squirrels (*Tamias*, *Citellus*, *Spermophilus*). Specimen TRO 390 is slender, relatively straight, the tibial crest terminates in the proximal one-fourth of the total length, and the distal articular grooves (especially the medial) are not well defined as in tree squirrels and in contrast to the sturdy, curved tibiae of ground squirrels in which the tibial crest reaches approximately one-third the length and the articular grooves are more sharply defined. These similarities support the conclusion of Black (1963), based on dental characters, that *Protosciurus* was a tree squirrel.

Protosciurus occurs from the Chadronian (*?Protosciurus jeffersoni*; Black, 1965) or Orellan to the Pre-Harrison Arikarean (Black, 1963). This occurrence of *Protosciurus* at SB-1A would appear to be one of its latest occurrences.

AGE OF THE FAUNA

The SB-1A Local Fauna contains genera which are found in Arikarean and Hemingfordian deposits outside of Florida and could conceivably be referred to either age. *Phlaocyon* (Matthew, 1901; Galbreath, 1953) and *Nothokemus* (Patton, 1969) are the most